

REMARKS

Claims 1-22 are presented for examination. Claims 1-5, 10-14, 18-19, and 21 have been amended. Claims 5 and 14 have been re-written in independent form. No new matter has been entered.

In the most recent Office Action, the Examiner rejected claims 1-22 under 35 USC §112, second paragraph, as indefinite. Applicants have now amended those rejected claims. Specifically, in claims 1, 2, 10, and 11, the wording of the recited Markush groups has been revised in accordance with the Examiner’s helpful suggestions. Claims 5 and 14 have been re-written in independent form so that there is no longer any conflict with limitations found in claims 1 and 10.

In claims 1, 2, 4, 10, 11, and 13, the Examiner objected to the use of the subscript “n” in the recited formulas as being an undefined term rendering those claims indefinite. Applicants submit that the use of “n” in the recited formulas is simply an expression of the degree of polymerization (i.e., number of repeating monomer units) where n can be any number greater than 1. Applicants submit that the expression as used would be recognized and understood by those skilled in the art. Applicants submit that the claims are in compliance with §112.

Also in the Office Action, the Examiner rejected claims 1-8, 10-17, and 19-22 under 35 USC 103 as unpatentable over Nozue et al (US 4626556), Yagihashi (US 6340735), Aiba et al (US 5183846), Linde et al (US 5043789) and Li et al (US 2003/0171476). Per the Examiner, Nozue, Yagihashi, and Aiba describe silsesquioxane *ladder* polymers that can be coated onto a conductive substrate. Linde was said to disclose a planarizing silsesquioxane copolymer, and Li was said to describe a silsesquioxane polymer containing colloidal silica. The Examiner concluded that it would have been obvious to “utilize [the] disclosure[s] of Yagihashi, Aiba et al, Linde et al, and Li et al in the invention of Nozue et al to optimize [the] coating composition for desired adhesion, strength and dielectric constant for the given application.” Action, page 5.

The claimed dielectric coatings are particularly useful on flexible electrically conductive substrates such as stainless steel foils. The coatings are formed from silane-based starting materials as described in the specification and are cured to produce polymers having a network structure. See, page 4, paragraph [0010]. This structure is to be distinguished from the ladder

structure mentioned in several of the cited prior art references. As is known in the art, silsesquioxanes can be polymerized, depending upon the starting monomers or oligomers, into either highly regular and crystalline ladder structures or random amorphous network structures.

The network polymer structures claimed by applicants provide several distinct advantages over prior art ladder polymers. Because the network structures are amorphous, the dielectric coatings exhibit excellent resistance to high temperatures such as those that would be encountered during a CIGS process to fabricate a photovoltaic cell. See, page 2, paragraph [0005]. The network structures, being amorphous, resist cracking from flexing better than crystalline ladder structures and provide a better match to the coefficient of thermal expansion for the conductive substrate.

The cured dielectric coatings described in the present application possess excellent adhesion to flexible conductive substrates, even after thermal shock, as evidenced by the examples in the specification which used cryoscopic microtomy. See, Examples 1 and 3. The coatings also possess a high temperature stability as evidenced by the examples in the specification. See, Example 1 in which the coated substrate was used to build a photovoltaic cell based on CIGS deposition technology. As described in the specification at page 2, the CIGS process requires exposures to temperatures in the range of 550°C for at least an hour.

The Examiner conceded in the Office Action that Nozue, Yagihashi, and Aiba all teach ladder polymer structures. Linde does as well; see, Abstract (“layer of ladder-type silsesquioxane copolymer”). Thus, Nozue describes an organopolysilsesquioxane ***ladder*** polymer, not a network polymer as claimed. Crystalline ladder polymers are not as resistant to cracking, which can cause electrical shorts between adjacent conductive layers in a photovoltaic cell.

Applicants also believe that a ladder polymer would not be able to withstand the fabrication conditions of CIGS-based photovoltaic devices. The thermal stability of the compositions in Nozue are provided as “decomposition temperatures in nitrogen.” Although there is no detailed explanation, it is most probably done using thermo-gravimetric analysis. If so, significant losses appear above the aforementioned instances. These temperatures, although close to those needed to fabricate photovoltaic devices, suggest that the coatings in Nozue would not be robust enough to fabricate photovoltaic devices particularly of the CIGS type where the

coatings are being exposed for long periods of time to high temperatures of up to 550°C. Further, the coatings that are described in Nozue require the use of light or ionizing radiation. Because of this different reaction mechanism, applicants believe that a polymer having a ladder structure is produced, which structure differs from that which is claimed. The claimed dielectric network polymers do not require light or ionizing radiation to form. All of the examples in Nozue include the presence of a radiation sensitive component or group.

Yagihashi also teaches a very different synthesis procedure than that used in the present application. Thus, the ladder polymers taught by Yagihashi are different from the network polymers described and claimed in the present application. And, Yagihashi *requires a ladder polymer* in order to be able to dissolve the polymer in a solvent so that the polymer can be spin coated onto a substrate. Further, the synthesis method of Yagihashi requires the use of a 1,3,5,7-tetraphenylcyclotetrasiloxane-1,3,5,7-tetraol precursor. The methods of preparation of applicants’ claimed coatings do not use this particular type of tetra-cyclic precursor, and therefore, the resulting cured coatings do not have a ladder structure, but form an amorphous network upon curing / annealing.

Aiba describes silicone *ladder polymers*, not the network polymers described and claimed by applicants. The structures of these polymers differ from the structures of the polymers in the present application which are random networks in their cured and uncured form. Further, Aiba *requires* ladder polymers so that they can be dissolved in a solvent and be spin coated onto substrates. In addition, there is no indication that the coatings of Aiba can tolerate continuous exposure to very high temperatures during, for example, a CIGS process photovoltaic device fabrication without shorting out, losing their planarity, or cracking.

Linde also teach the preparation of *ladder-type polymers*, not the network polymers described and claimed by applicants. Such ladder-type polymers differ in both structure and properties from the claimed dielectric coatings. Again, as with the other applied references, the Linde process requires the use of an organic solvent to be able to spin coat the polymer. See, claim 1.

As all of Nozue, Yagihashi, Aiba, and Linde produce and use ladder polymers, even if their teaching were to be combined in the manner proposed by the Examiner, the claimed dielectric coating having a network structure would not result. No amount of “optimization” of a

ladder polymer structure would arrive at the claimed *network polymer* structure. And, as shown by applicants, such a network structure provides distinct advantages over prior art ladder-type structures in terms of resistance to cracking and high temperature resistance. Applicants submit that the claims as amended patentably distinguish over the teachings of these references.

For all of the above reasons, applicants submit that claims 1-22, as amended, are patentable over the cited and applied prior art and are in compliance with §112. Early notification of allowable subject matter is respectfully solicited.

Respectfully submitted,
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